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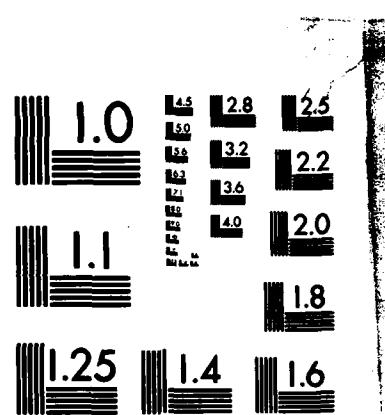
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## STATUS OF AUTO CARTO AT THE DEFENSE MAPPING AGENCY

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### ABSTRACT

During the last year, DMA has focused on increased utilization of auto carto techniques and processes in production. Although significant auto carto capabilities have existed in the past, a combination of a balancing of production emphasis and software development is now providing increased automation in map and chart production.

Discussed are developments in exploiting digital product data for maps and charts and the family of products concept. Applications of scale conversion through digital processes using existing reformat source for smaller scale maps are reviewed. New applications of auto carto scheduled for integration into production in the near future are also discussed.

### BACKGROUND

The use of automation in the cartographic processes of compilation, revision and color separation is not new to DMA. In the early and mid 1970's, several different systems were used in the production of maps, aeronautical and nautical charts. Key among these systems was the Semi Automated Cartographic System (SACARTS). It provided for digitizing compilation manuscripts, performing editing of the digitized data as well as other functions inherent in the development of symbolized map data, and producing color separation plates. Also of significance was the Linear Input System, or LIS, a manual digitizing system which provided DMA's primary digitizing capability for many years.

During the late 1970's and early 1980's, the DMA emphasis was on producing digital data products for weapon systems. This emphasis was, to a certain extent, at the expense of auto carto. However, during this period, several significant things happened. Computer technology, such as higher density storage media required to support auto carto in the DMA environment, became available. It also became apparent that the possibility existed for utilizing a significant portion of the vast amount of digital product data for charting purposes. Raster based systems became available for more efficient digitizing. Adding to this has been a shifting of production emphasis that has allowed increased focus on auto carto development and implementation. All of these actions have placed auto carto in a significant role in the current and future DMA production plans.

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### EXPLOITATION OF DIGITAL DATA

DMA has a large amount of digital data which has been produced to support weapon systems and simulators for flight training. This data takes many formats but two of the most common are Digital Terrain Elevation Data (DTED) and Digital Feature Analysis Data (DFAD). Both products are part of the Digital Landmass System (DLMS). DTED consists of matrices of terrain elevations. DFAD consists of data representing point, line and area features, including positioning and descriptive data.

The use of DTED in chart production has been an early application of auto carto to exploit digital data. Software has been developed to plot contours from the DTED data base at selected intervals and at different projections. This process has been integrated into the production of 1:200,000 scale aeronautical charts and is now being tested for other scales.

The indications from production of the first sheets are that a resource savings of about 10-15% is common in the use of DTED over previous manual compilation methods. As production procedures are refined, it is expected that the savings will increase.

The use of DFAD for charting purposes has also been achieved in prototype production. Aeronautical charts at the 1:200,000 scale depict the radar significance of planimetric features. Previously, compilation of these Radar Significant Analysis Codes (RSAC) has been a manual operation. Software has now been developed to use the DFAD for RSAC generation, and a prototype sheet has been evaluated favorably by the user community. Some problems exist, however. As an example, the DFAD does not contain all of the RSAC features which the map specifications require. Small bridges which are radar significant are an example. This situation is expected to cause a reconciliation of the chart specification and the DFAD specification.

The use of these digital terrain and feature data bases for maps and charts shows substantial promise. It forms the basis for a "family of products" concept, an approach which, when fully developed, would provide for multi-product data bases satisfying DMA digital and map/chart product requirements. Incumbent in this approach and in the initial production described above is increased compatibility of digital and map/chart products. Another demonstrated benefit has been the resource savings and compression of pipeline time. The problems of matching digital capabilities with traditional map/chart specifications as well as matching map/chart production schedules with digital production so as to exploit the digital data base for maps and charts still remain to be solved.

### AUTOMATED TECHNIQUES USING CARTOGRAPHIC SOURCE

Another area in which DMA is now in prototype production is scale conversion for the production of smaller scale maps/charts from existing reformat and/or digital data. The first sheet to be produced in this manner will be at the 1:100,000 scale using 1:50,000 scale reformat as the source. Digitization of existing film negatives (with the exception of the contour plate) is being accomplished using the SCITEX Response 250, a color raster/graphic edit system with laser plotter. For the prototype, DTED was available (at the proper

refinement level) and contours will be produced at the smaller scale from the DTED data base. For future sheets, if DTED is not available, the existing 1:50,000 contour plates would be digitized on the Automatic Graphic Digitizing System (AGDS), a raster scanning, vectorizing and editing system. After processing on the AGDS, digitized contour data would be converted to DTED, and then plotted at the smaller scale. The digitized planimetric/hydrographic data from the four 1:50,000 source sheets are panelled and merged on the SCITEX system and reduced to 1:100,000 scale. Selection of features to be portrayed at 1:100,000 scale, feature generalization, and symbolized feature displacement are performed interactively on the SCITEX.

Substantial work remains to be done, however, in that software to filter out features not required for the smaller scale, as well as feature generalization and displacement are to be developed. Once again, this is an application of auto carto where evaluation of existing map/chart specifications, based on manual compilation, might result in a specification revision for a closer match with auto carto capabilities.

The application of auto carto techniques also is being effective in the production of nautical charts. These charts typically are at 1:75,000 scale and depict hydrographic as well as topographic and planimetric features. Imagery used for the topography and shoreline is compiled on the AS11 analytical stereoplotter and the resultant manuscript is scanned on the SCITEX, producing a preliminary color separate. The Advanced Cartographic Data Digitizing Systems (ACDDS), a vector formatted digitization and compilation system, is used for compilation of the hydrographic data using the shoreline color separate discussed above for control. The SCITEX was also used for preparation of text and area feature guides. The CRT printhead plotter, a high speed vector formatted plotter capable of producing reproducible quality film positives, was used to produce the symbolized color separates of the hydrographic data and the SCITEX plotter to produce separates of the topography, text and open window negatives. Type placement was originally done on the SCITEX; however, experience has shown this to be a very labor intensive operation and software has been developed to do type placement on the ACDDS with output to the CRT printhead plotter.

Work remains to be done in this application of auto carto for nautical charts but it has already been incorporated into the production process with a savings of approximately 25% in resources and 33% in pipeline time. A data base (in a format to support nautical charts) has been developed and digital data from the compilation of each chart is entered into the data base. This data base promises even greater savings and faster response time for revisions of charts included in the data base.

#### AUTOMATION ENVIRONMENT

There are a number of related areas which have significance for auto carto development within DMA.

- o DMA is well into an upgrade of its large scale scientific and technical computers. This capacity will provide support as necessary, for the additional automation requirements of auto carto.

- o DMA is nearing finalization of a standard linear format for digital cartographic feature data which will be used by applicable auto carto systems and will facilitate inter system transfer of data.
- o DMA is developing an interactive, networked data base system. This system, when in place, will facilitate the access and utilization of MC&G data for cartographic applications.
- o A high speed (50 million bits/second) local area network is under development at each of the Production Centers. This capacity will facilitate the inter system transfer of digital data in auto carto production and will support the data base environment mentioned above.

Collectively these developments are putting into place a production environment that fosters the efficient generation of auto carto products, storage and retrieval of data elements and promotes interproduct commonality and compatibility.

#### DEVELOPMENT ACTIVITIES

DMA is laying the groundwork for a much broader auto carto program in future years through the development/acquisition of a number of systems and hardware items. These include:

- o Computer Assisted Photo Interpretation System (CAPI), which will extract feature data to support digital product programs and auto carto.
- o Cartographic Compilation Revision System (CCRS), which will provide the capability to use photographic, cartographic, or digital source for compilation, recompilation, and revision of map/chart features.
- o Advanced Edit System (AES), which will provide the capability to edit and plot symbolized digital data in the preparation of color separates.
- o Clustered Processing System (CPS), which is designed to mosaic, merge, and validate planimetric digital data to meet digital product requirements as well as support map/chart development.
- o Laser Platemaker, which will use digital data to produce a pressplate.
- o Compilation Revision Edit System (CRES), which will provide an interactive tagging/digitizing capability to edit and tag selective features for map/chart revision.

Integration of these systems into the production environment will occur principally in the 1983-1986 time frame. Implementation will be accompanied by development of a substantial amount of software to ensure interoperability of these and existing systems for auto carto.

#### SUMMARY

In the past, DMA has had the potential for development of a substantial auto carto program, but because of emphasis on production of digital products and

other considerations, a sustained significant production capability has only recently been established. There is strong incentive to continue development of auto carto, not only because of the traditional efficiencies of auto carto, but because of the potential to exploit the large digital product data bases and to increase compatibility of digital and map/chart products. Finally, an auto carto technology base exists in DMA now with plans and a commitment for expansion and development for the future.